Compositional Diversity in the South Pole-Aitken Basin (SPA) as Viewed by the Moon Mineralogy Mapper (M^3)

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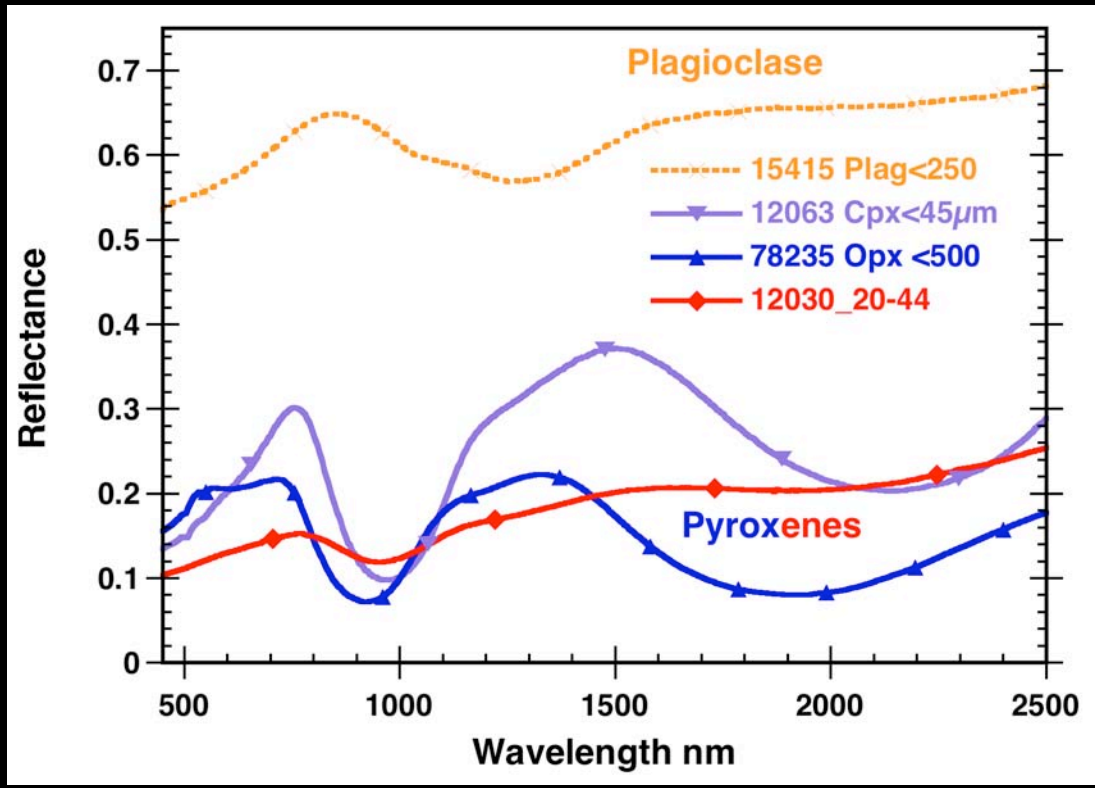
and the M^3 Science Team

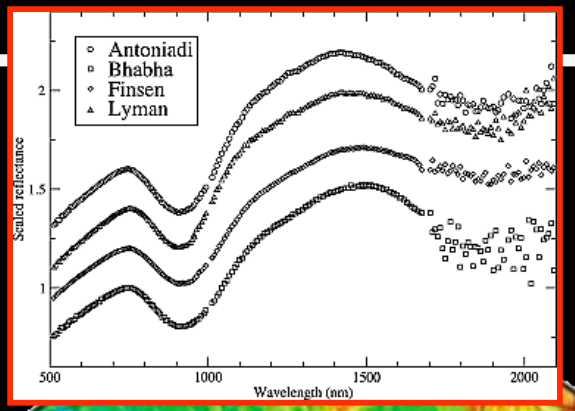
M^3 Instrument Overview

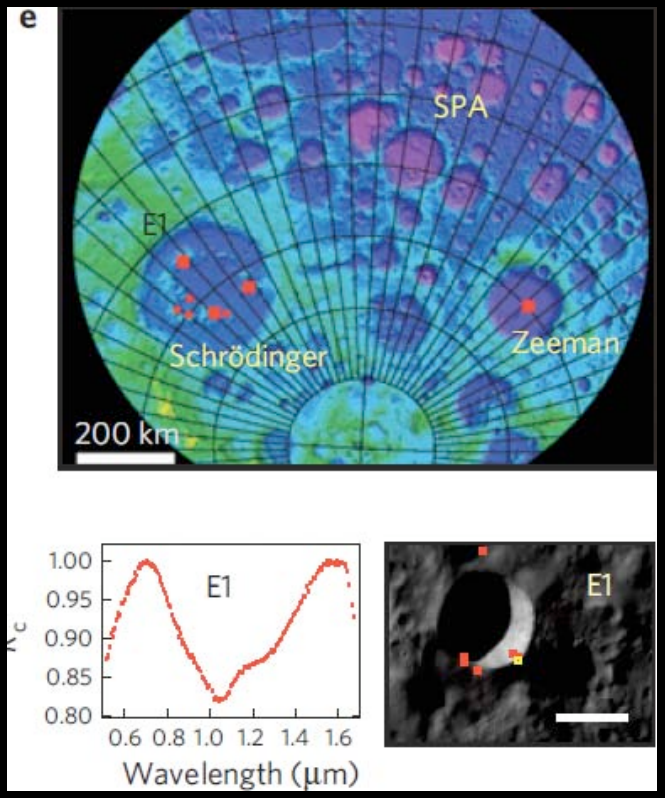
- M^3 was designed to characterize the diagnostic absorption features of common lunar minerals
- 140 m/pixel at 100 km orbit (but….)
- 86 spectral channels from 430 to 3000 nm

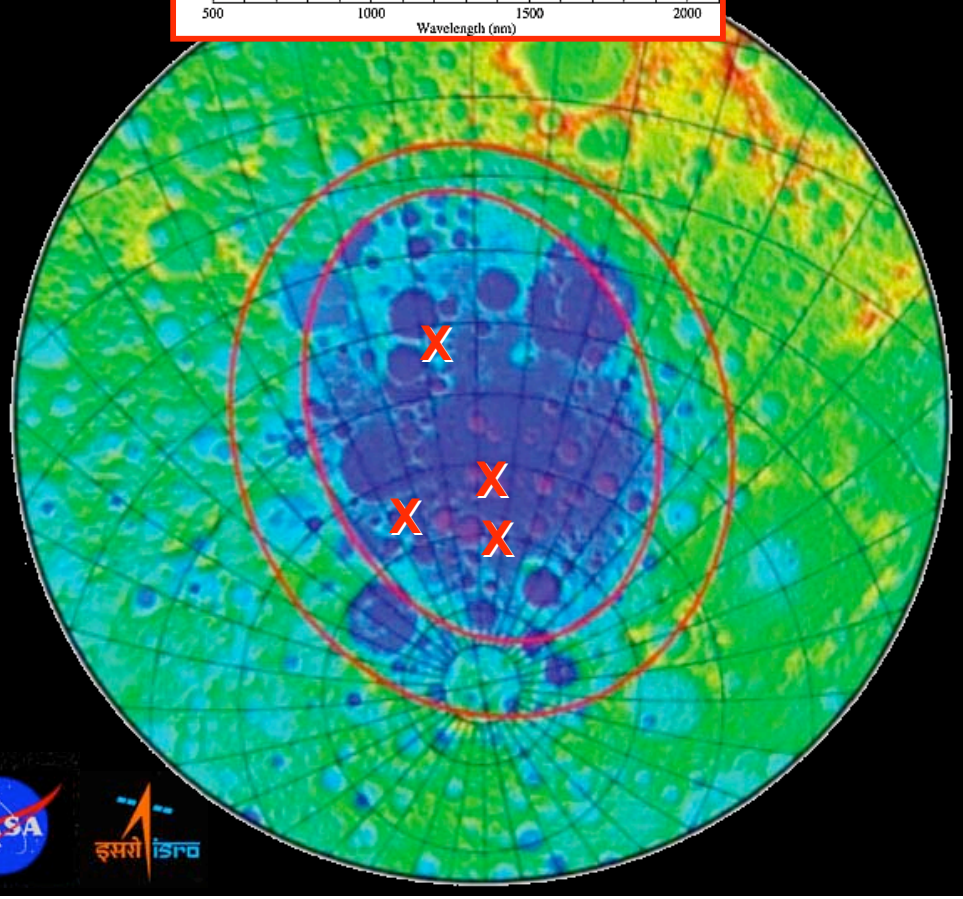


Kaguya Spectral Profiler Results

The central peaks of several large craters exhibit prominent features due to (crystalline) Mg-rich pyroxene. (Nakamura et al., 2009)
Olivine in Schrödinger and Zeeman. (Yamamoto et al., 2010)

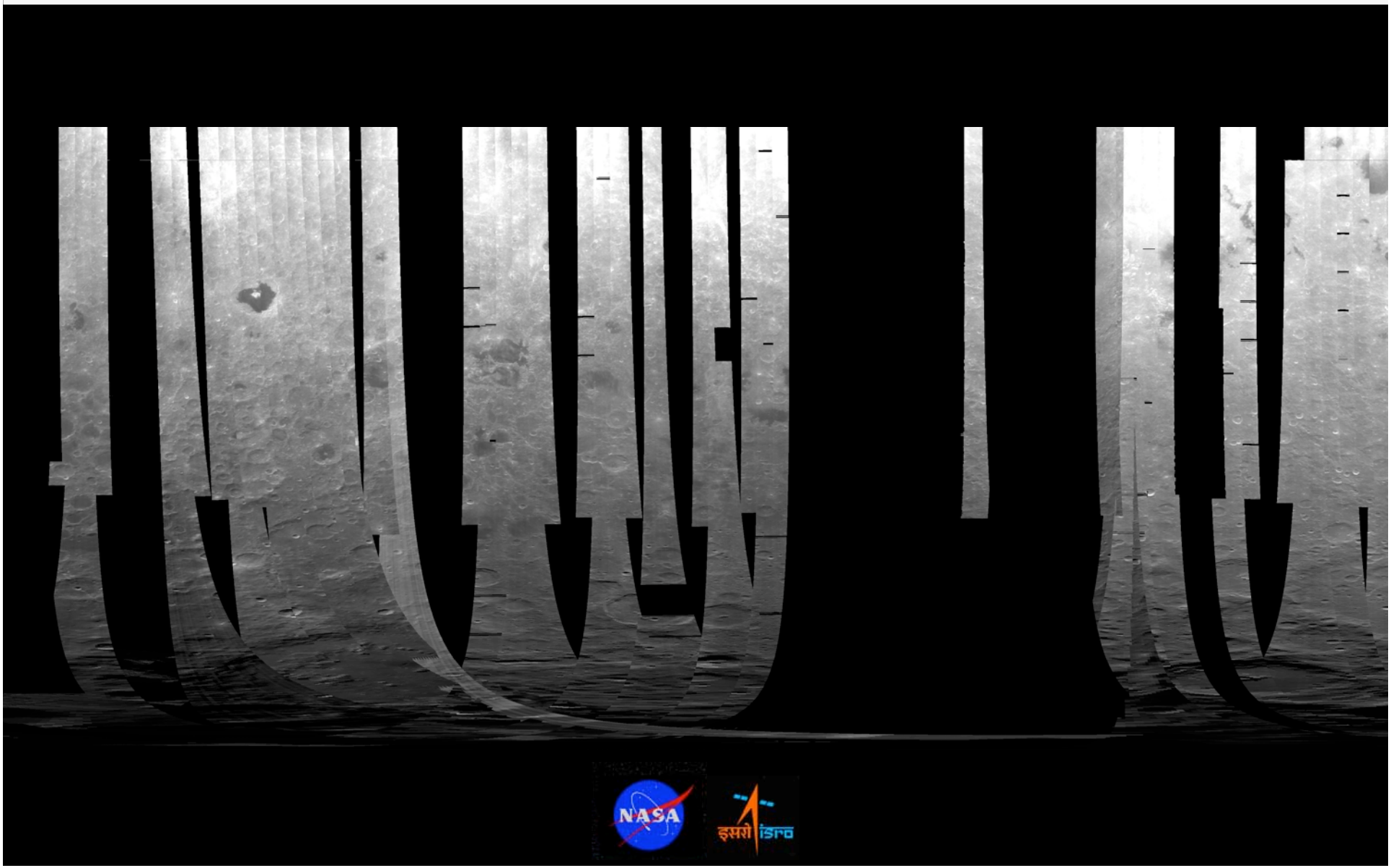




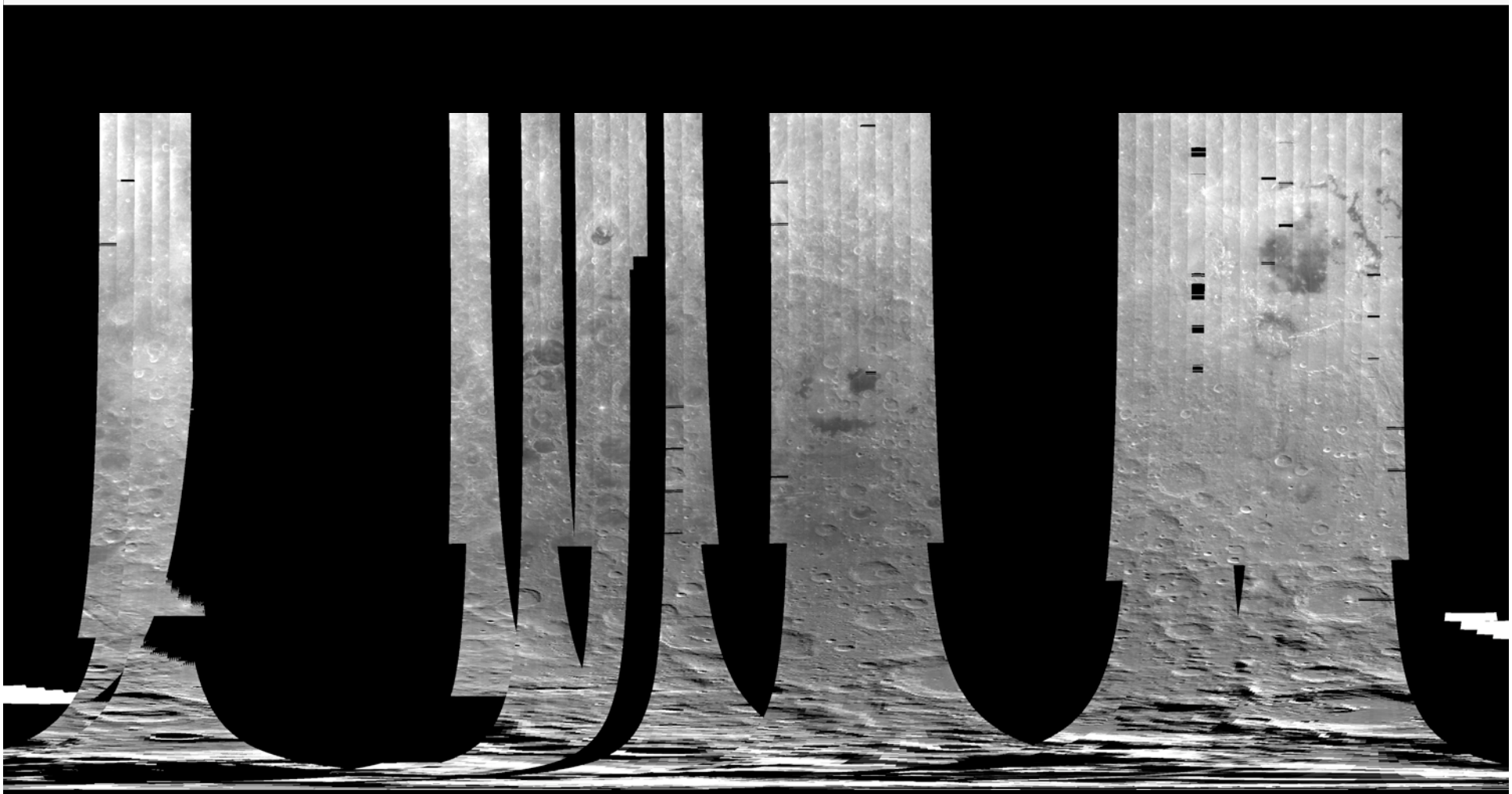


What did we get? OP2A @ 100km

What did we get? OP2C 1

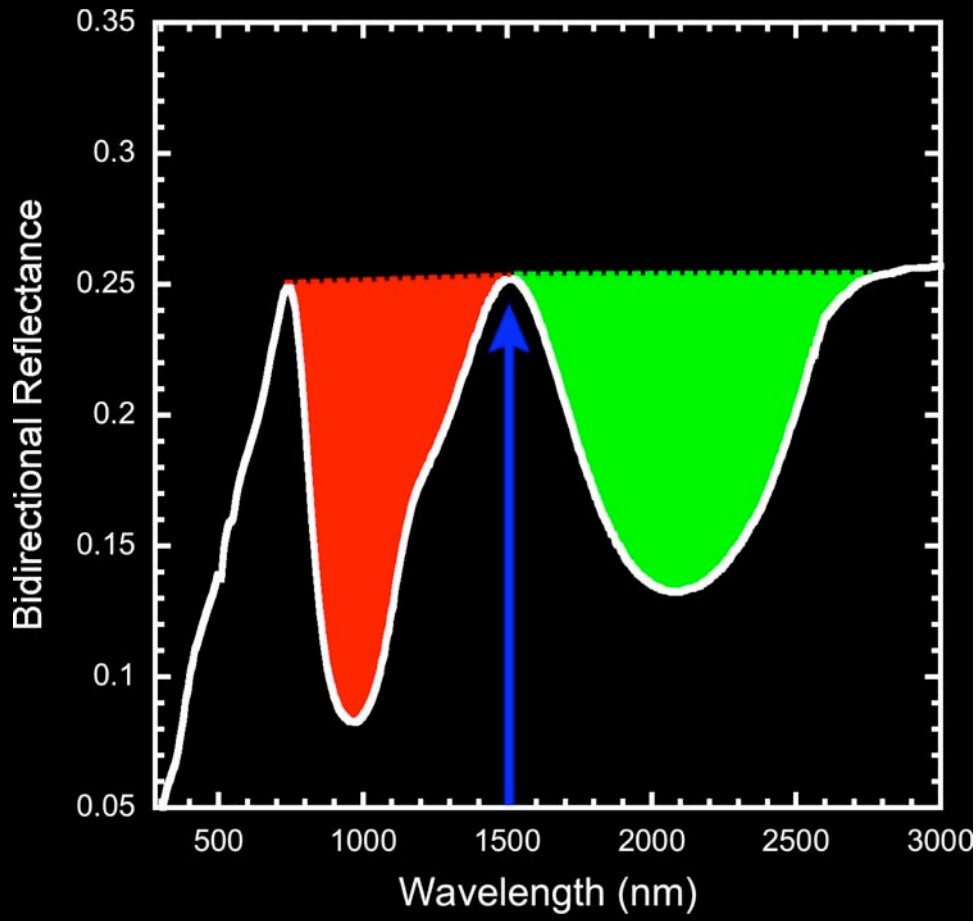


What did we get? OP2C 2

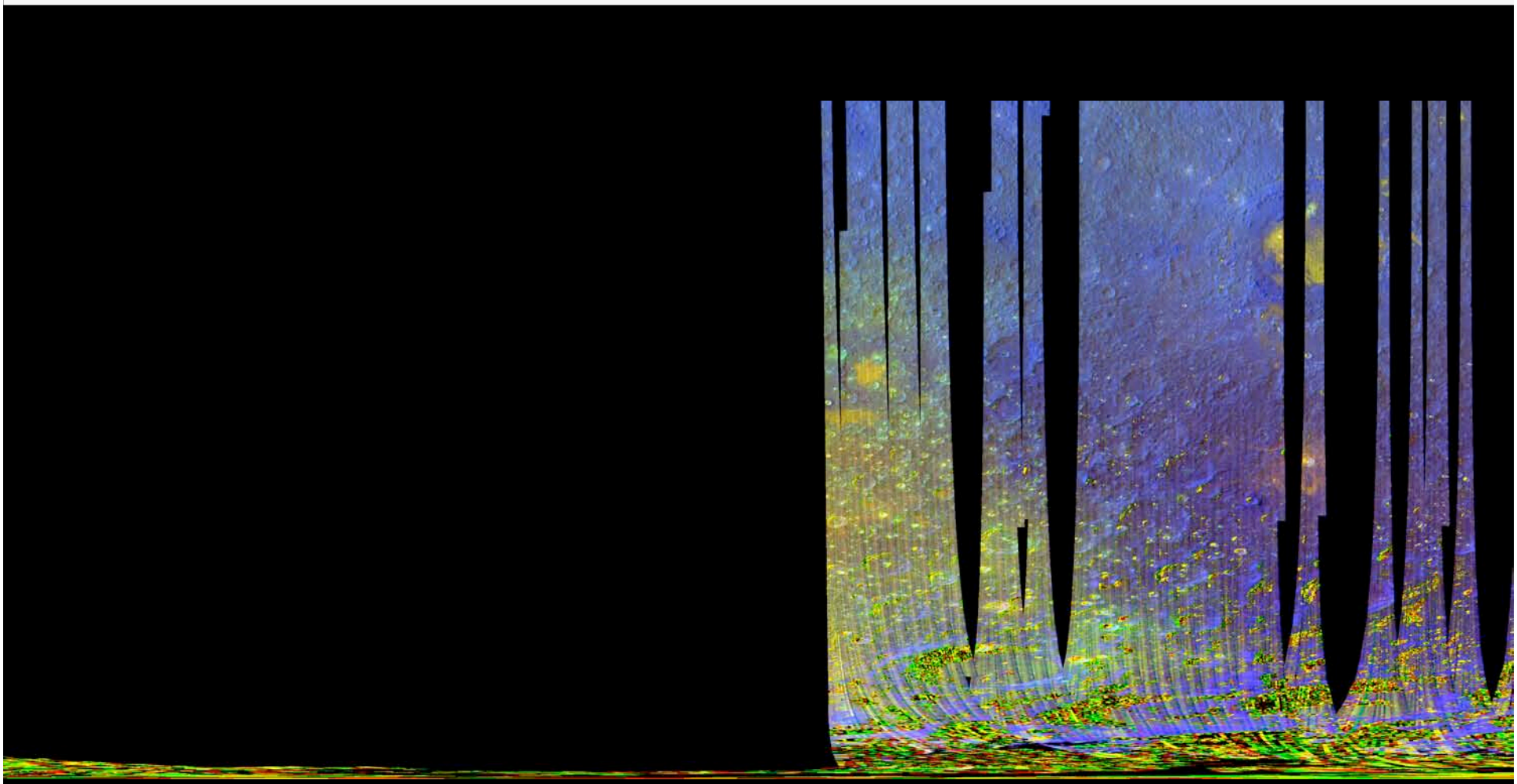


Strength of M^3

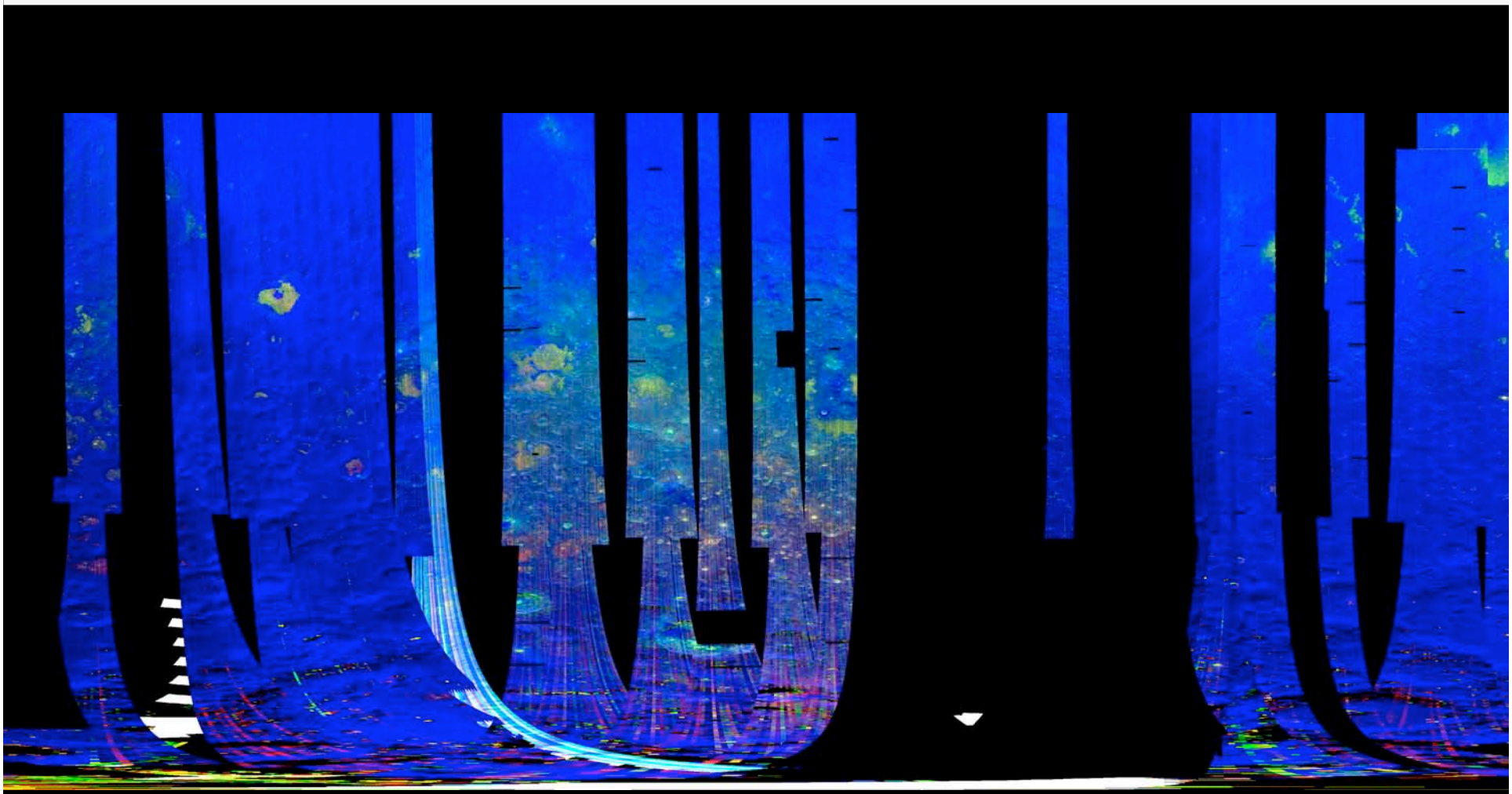
- Single bands are great, but the strength of M^3 comes from leveraging the spectral resolution
- Useful color composite leverages the integrated 1 and 2 micron band depths, and the albedo at 1580 microns



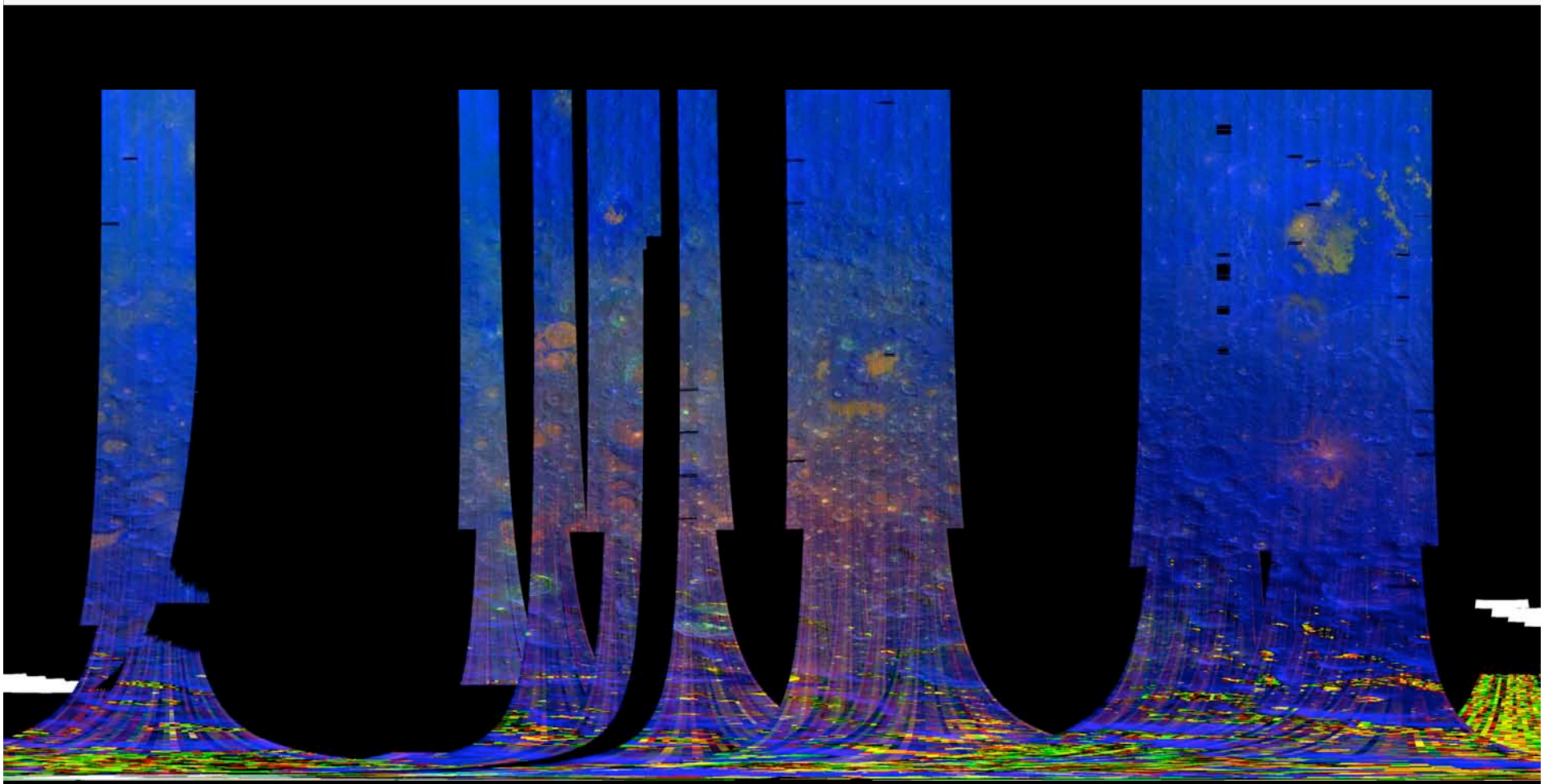
What did we get? OP2A @ 100km

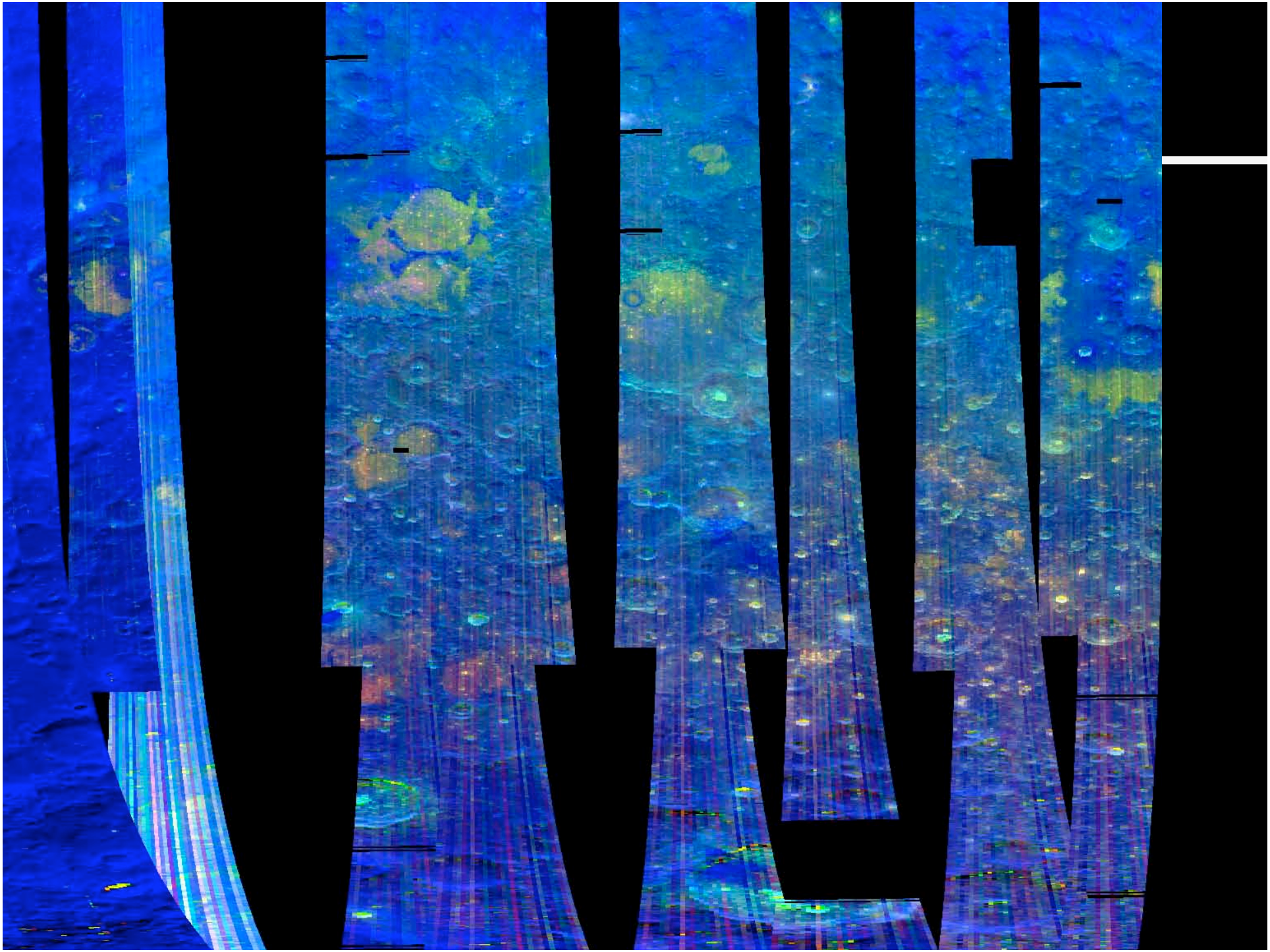


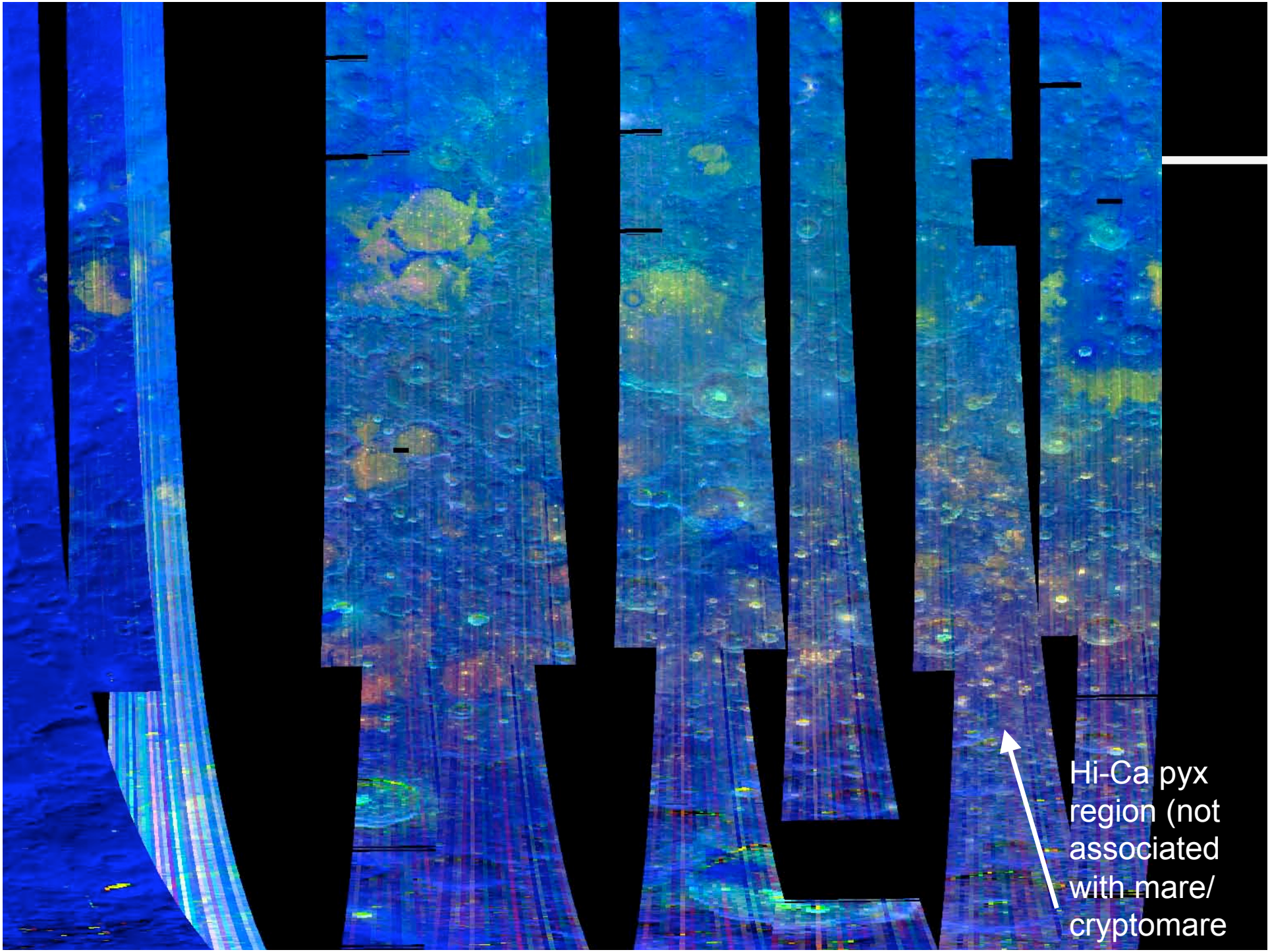
What did we get? OP2C 1

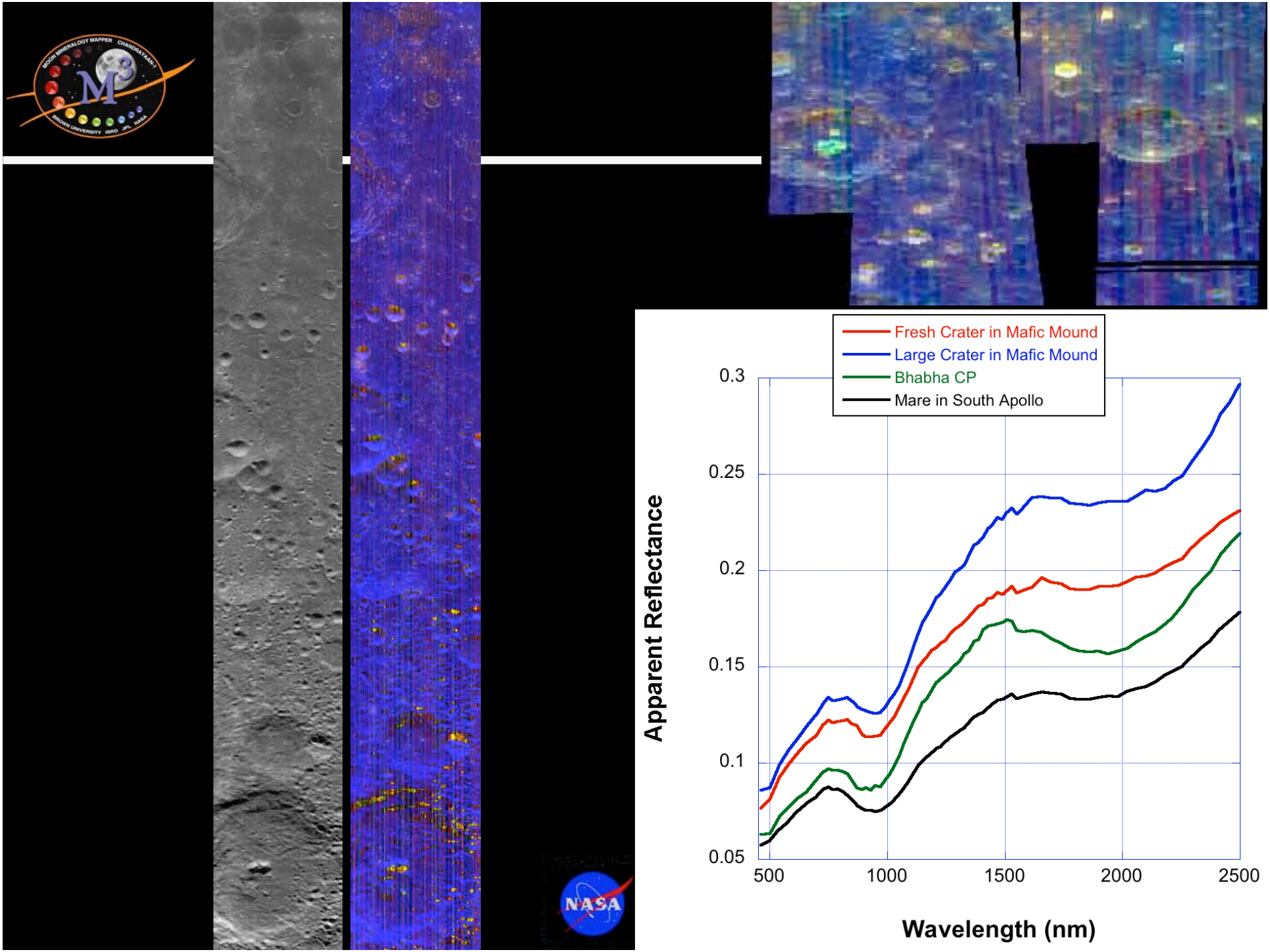


What did we get? OP2C 2

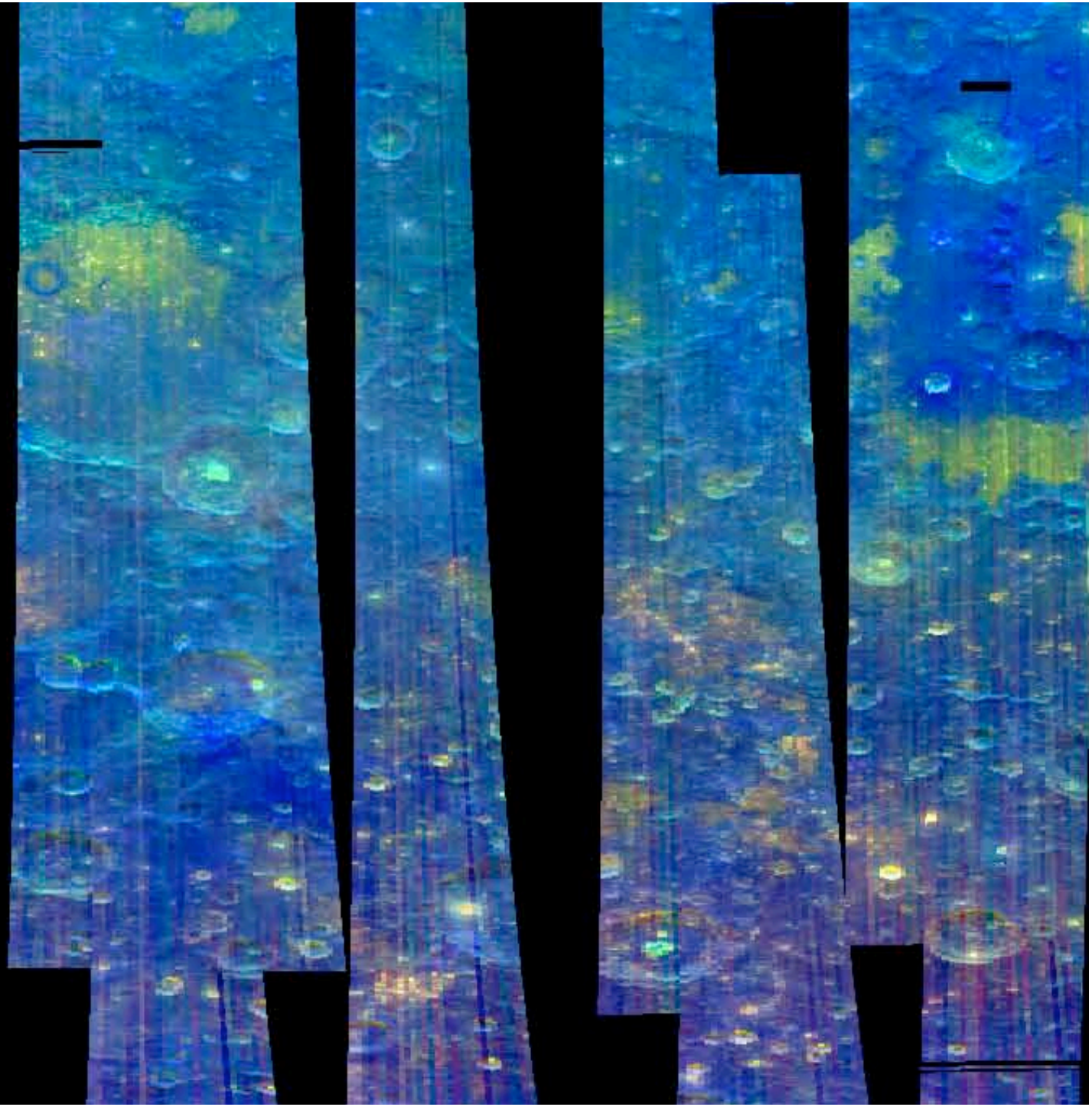





Hi-Ca pyx
region (not
associated
with mare/
cryptomare


Fresh Crater in Mafic Mound
Large Crater in Mafic Mound
Bhabha CP
Mare in South Apollo
Apparent Reflectance
0.3
0.25
0.2
0.15
0.1
0.05
500
1000
1500
2000
2500
Wavelength (nm)

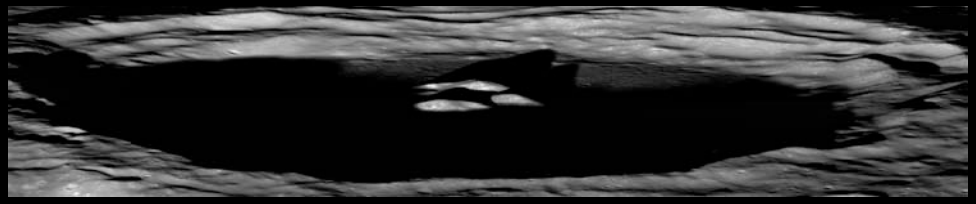
- Noritic material in Apollo is compositionally distinct (higher Mg) than noritic material outside Apollo
- High-Ca pyx. in middle of basin, over noritic material?



Current SPA Story…

- The highly noritic rock type seen in the central peaks of large craters represents excavated lower crustal material (below the impact melt) or a is derived from SPA impact melt (e.g., Nakamura et al., 2009).

- The rest of the mafic-rich SPA basin interior largely represents products of the SPA impact melt that have been reworked with time.
  - The moderately **noritic** SPA interior represents a mixed impact melt breccia of the crustal column produced during the impact event.
  - The **gabbroic** zone across the center of the basin a distinct portion of the impact melt and has not been homogenized with the rest. Overlies noritic material (Bhabha Central Peak)

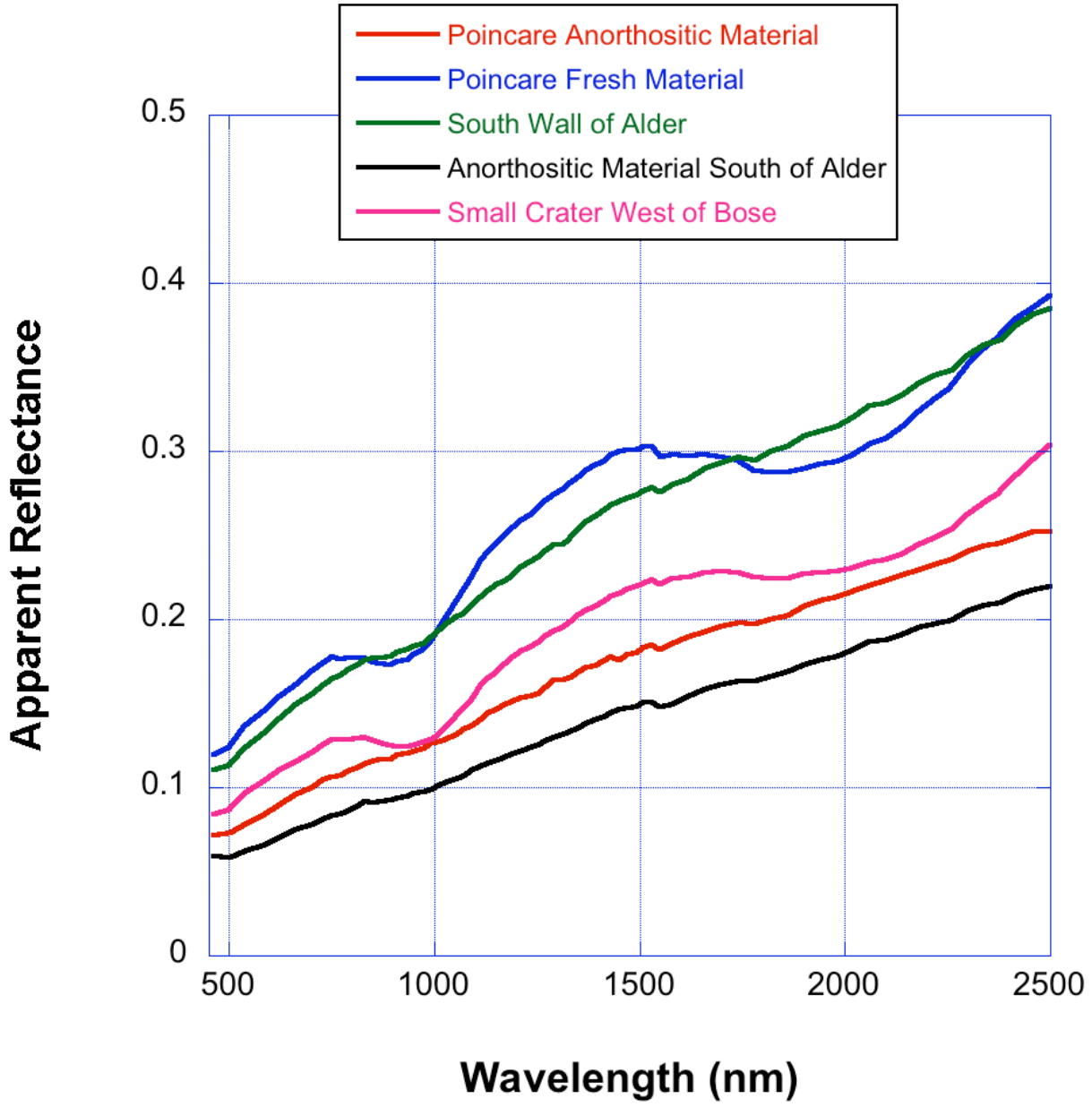


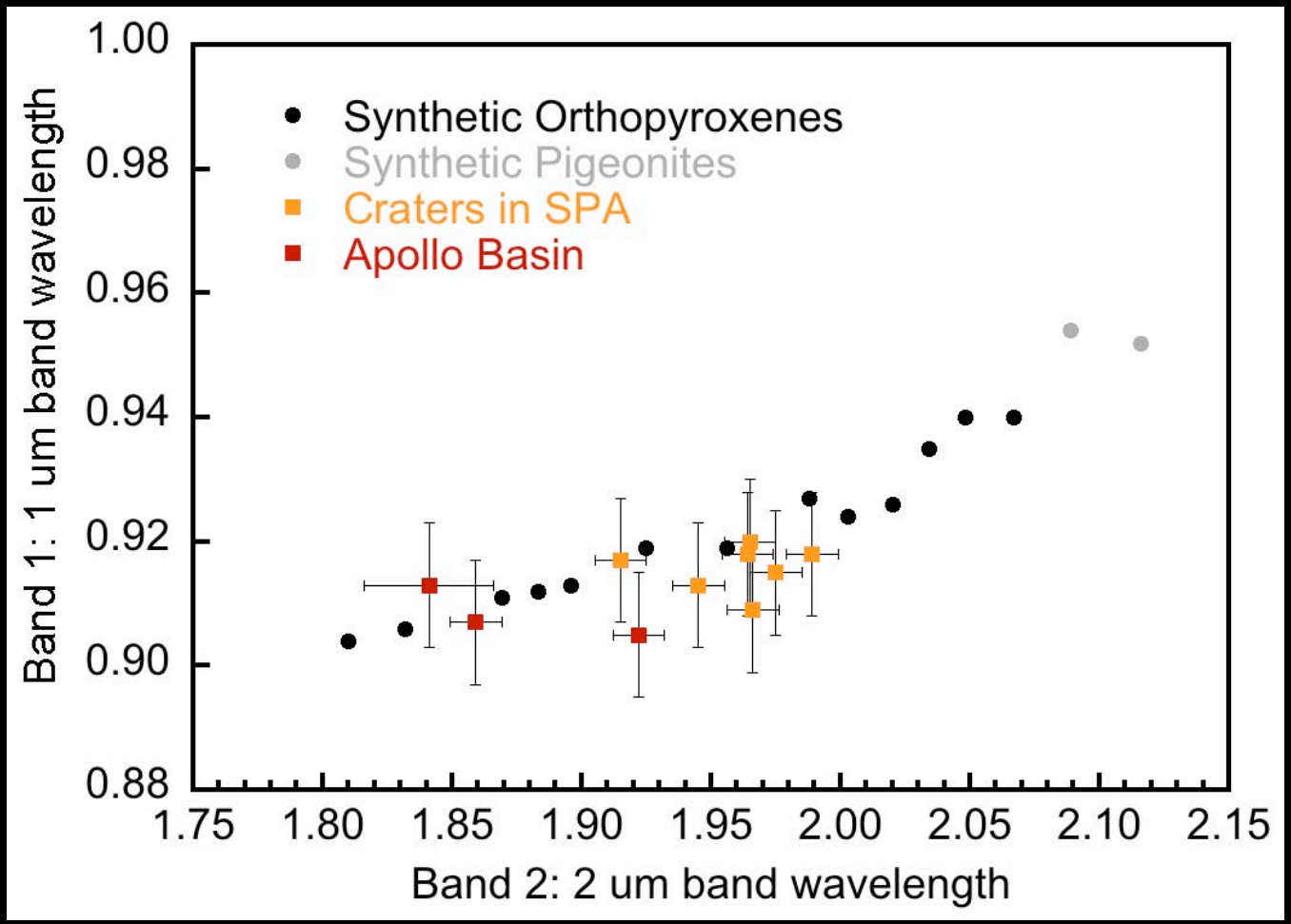
- The low-Fe bearing materials in SPA represent….


MOON MINERALOGY MAPPER
CHANDRAYAAN-1
M3
BROWN UNIVERSITY ISRO JPL NASA


NASA
इसरो isro

Low-FeO Material




Synthetic Orthopyroxenes
Synthetic Pigeonites
Craters in SPA
Apollo Basin
Band 1: 1 um band wavelength
1.00
0.98
0.96
0.94
0.92
0.90
0.88
1.75
1.80
1.85
1.90
1.95
2.00
2.05
2.10
2.15
Band 2: 2 um band wavelength